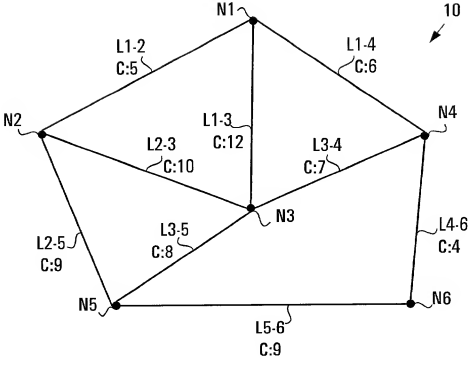


FIG. 1

1002214616201

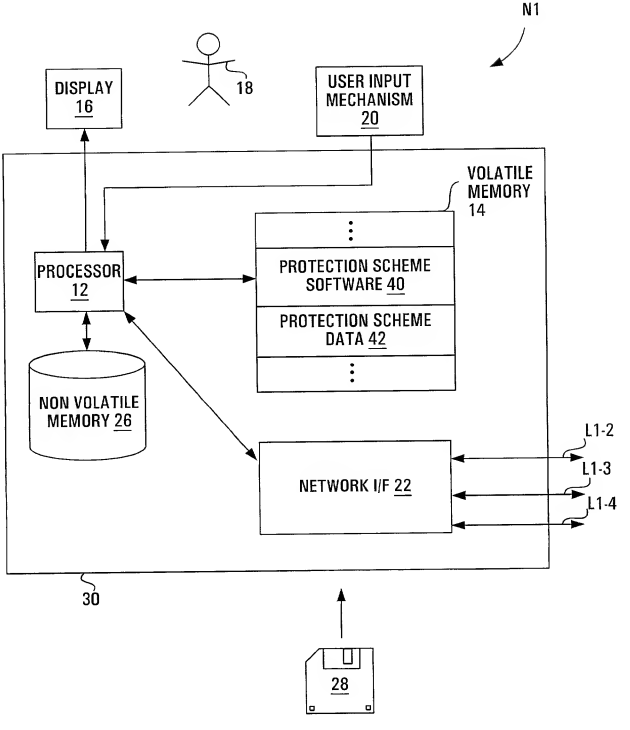
N1
DISPLAY 16
18
USER INPUT MECHANISM 20
VOLATILE MEMORY 14
PROCESSOR 12
PROTECTION SCHEME SOFTWARE 40
PROTECTION SCHEME DATA 42
NON VOLATILE MEMORY 26
NETWORK I/F 22
L1-2
L1-3
L1-4
30
28

FIG. 2

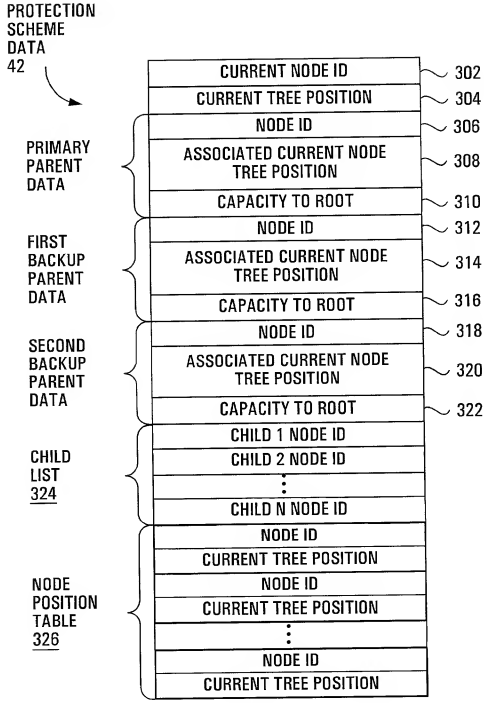


FIG. 3

10022516v1 22801

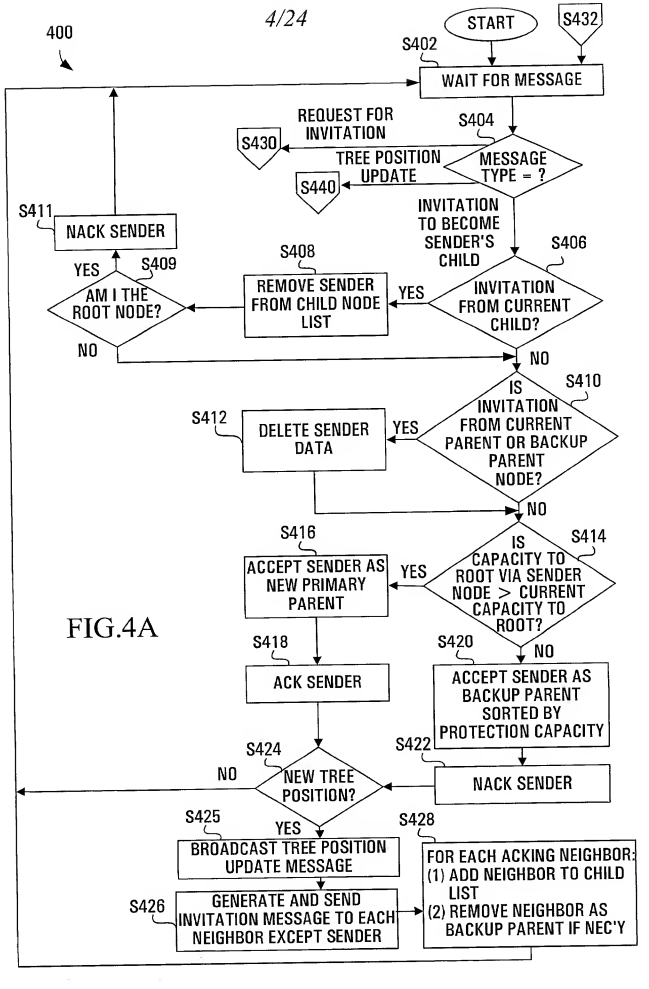


FIG.4A

T08221"46T6200F

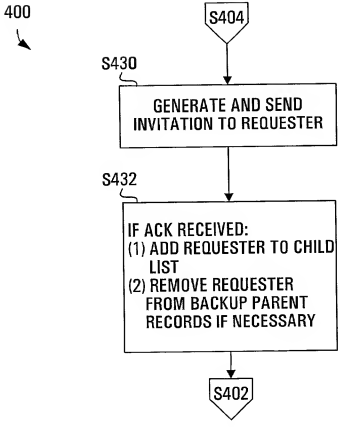
400
S404
S430
GENERATE AND SEND INVITATION TO REQUESTER
S432
IF ACK RECEIVED:
(1) ADD REQUESTER TO CHILD LIST
(2) REMOVE REQUESTER FROM BACKUP PARENT RECORDS IF NECESSARY
S402

FIG.4B

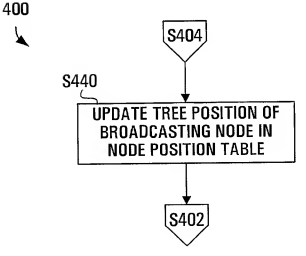
400
S404
S440
UPDATE TREE POSITION OF BROADCASTING NODE IN NODE POSITION TABLE
S402

FIG.4C

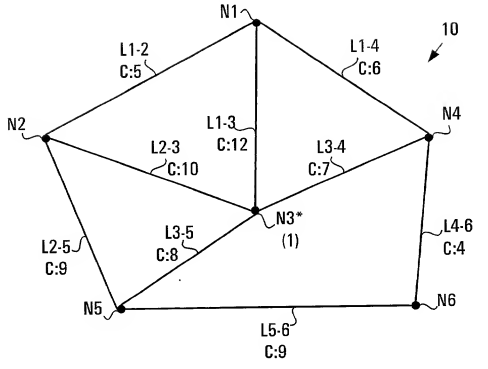
N1
10
L1-2
C:5
L1-4
C:6
N2
L1-3
C:12
N4
L2-3
C:10
L3-4
C:7
N3*
(1)
L4-6
C:4
L3-5
C:8
L2-5
C:9
N5
N6
L5-6
C:9

FIG.5A

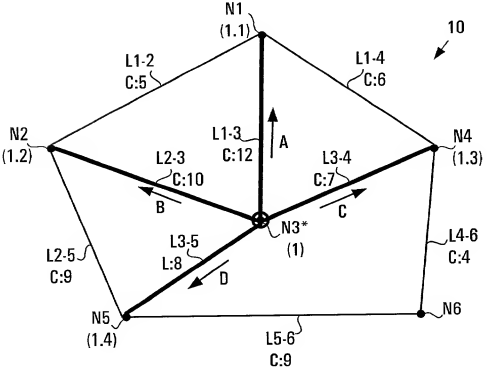
N1
(1.1)
10
L1-2
C:5
L1-4
C:6
N2
(1.2)
L1-3
C:12
A
N4
(1.3)
L2-3
C:10
L3-4
C:7
B
C
N3*
(1)
L4-6
C:4
L3-5
L:8
L2-5
C:9
D
N5
(1.4)
N6
L5-6
C:9

FIG.5B

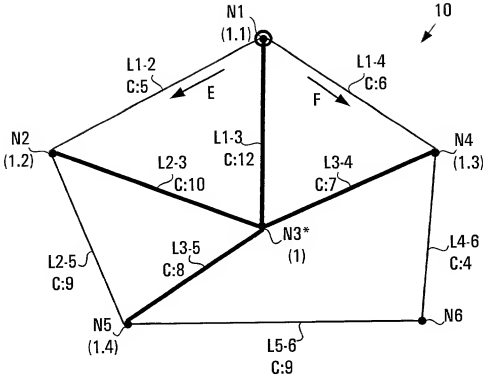


FIG.5C

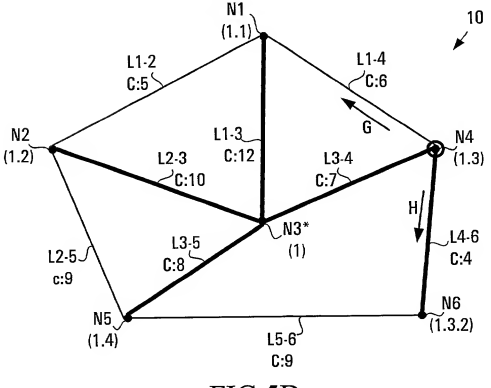


FIG.5D

10021221-061602001

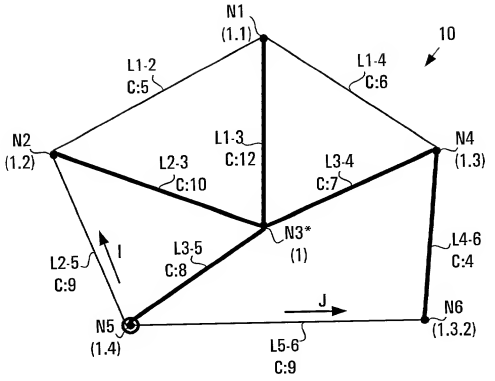
N1
(1.1)
10
L1-2
C:5
L1-4
C:6
N2
(1.2)
L1-3
C:12
N4
(1.3)
L2-3
C:10
L3-4
C:7
N3*
(1)
L4-6
C:4
L2-5
C:9
I
L3-5
C:8
J
N6
(1.3.2)
N5
(1.4)
L5-6
C:9

FIG.5E

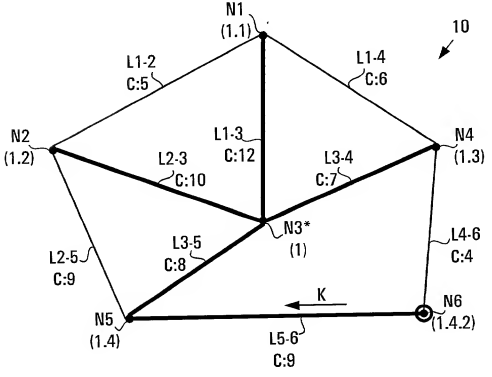
N1
(1.1)
10
L1-2
C:5
L1-4
C:6
N2
(1.2)
L1-3
C:12
N4
(1.3)
L2-3
C:10
L3-4
C:7
N3*
(1)
L4-6
C:4
L2-5
C:9
L3-5
C:8
K
N6
(1.4.2)
N5
(1.4)
L5-6
C:9

FIG.5F

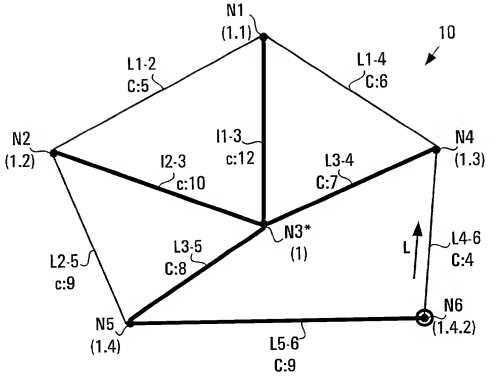


FIG.5G

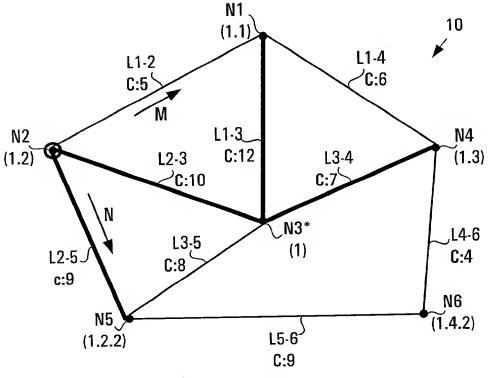


FIG.5H

1002941946 - 12/28/01

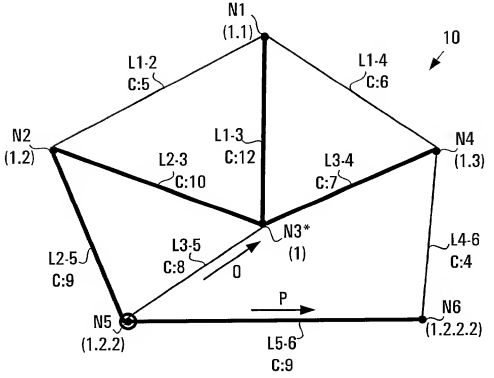
N1
(1.1)
10
L1-2
C:5
L1-4
C:6
N2
(1.2)
L1-3
C:12
N4
(1.3)
L2-3
C:10
L3-4
C:7
N3*
(1)
L3-5
C:8
L4-6
C:4
L2-5
C:9
Q
P
N5
(1.2.2)
N6
(1.2.2.2)
L5-6
C:9

FIG. 5I

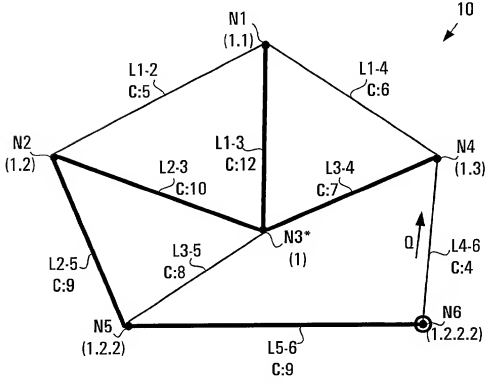
N1
(1.1)
10
L1-2
C:5
L1-4
C:6
N2
(1.2)
L1-3
C:12
N4
(1.3)
L2-3
C:10
L3-4
C:7
N3*
(1)
Q
L3-5
C:8
L4-6
C:4
L2-5
C:9
N5
(1.2.2)
N6
(1.2.2.2)
L5-6
C:9

FIG. 5J

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | cur-rent node ID | current tree position | parent node information | | | | | | | | |
| | | | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | | | 0 | | | | | | |
| 2 | N2 | - | | | 0 | | | | | | |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | | | 0 | | | | | | |
| 5 | N5 | - | | | 0 | | | | | | |
| 6 | N6 | - | | | 0 | | | | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | | | | | |
| 3 | N3* | | | | | |
| 4 | N4 | | | | | |
| 5 | N5 | | | | | |
| 6 | N6 | | | | | |

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FIG. 6A

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | node ID | current tree position | parent node information | | | | | | | | |
| | | | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | tree position | capacity to root node (max) | node ID | tree position | capacity to root node (max) | node ID | tree position | capacity to root node (max) |
| 1 | N1 | - | **N3** | **1.1** | **12** | | | | | | |
| 2 | N2 | - | **N3** | **1.2** | **10** | | | | | | |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | **N3** | **1.3** | **7** | | | | | | |
| 5 | N5 | - | **N3** | **1.4** | **8** | | | | | | |
| 6 | N6 | - | | | 0 | | | | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | | | | | |
| 3 | N3* | **N1** | **N2** | **N4** | **N5** | |
| 4 | N4 | | | | | |
| 5 | N5 | | | | | |
| 6 | N6 | | | | | |

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**FIG. 6B**

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | parent node information | | | | | | | | |
| | | | parent node | | | first backup parent node | | | second backup parent node | | |
| | current node ID | current tree position | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | | | | | | |
| 2 | N2 | - | N3 | 1.2 | 10 | **N1** | **1.1.1** | **5** | | | |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | **N1** | **1.1.2** | **6** | | | |
| 5 | N5 | - | N3 | 1.4 | 8 | | | | | | |
| 6 | N6 | - | | | 0 | | | | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | | | | | |
| 3 | N3* | N1 | N2 | N4 | N5 | |
| 4 | N4 | | | | | |
| 5 | N5 | | | | | |
| 6 | N6 | | | | | |

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FIG. 6C

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | parent node information | | | | | | | | |
| | current node ID | current tree position | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | **N4** | **1.3.1** | **6** | | | |
| 2 | N2 | - | N3 | 1.2 | 10 | N1 | 1.1.1 | 5 | | | |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | N1 | 1.1.2 | 6 | | | |
| 5 | N5 | - | N3 | 1.4 | 8 | | | | | | |
| 6 | N6 | - | **N4** | **1.3.2** | **4** | | | | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | | | | | |
| 3 | N3* | N1 | N2 | N4 | N5 | |
| 4 | N4 | **N6** | | | | |
| 5 | N5 | | | | | |
| 6 | N6 | | | | | |

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**FIG. 6D**

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | parent node information | | | | | | | | |
| | current node ID | current tree position | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | N4 | 1.3.1 | 6 | | | |
| 2 | N2 | - | N3 | 1.2 | 10 | ~~N5~~ ~~N1~~ | ~~1.4.1~~ ~~1.1.1~~ | ~~8~~ ~~5~~ | N1 | 1.1.1 | 5 |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | N1 | 1.1.2 | 6 | | | |
| 5 | N5 | - | N3 | 1.4 | 8 | | | | | | |
| 6 | N6 | - | N4 | 1.3.2 | 4 | | | | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | | | | | |
| 3 | N3* | N1 | N2 | N4 | N5 | |
| 4 | N4 | N6 | | | | |
| 5 | N5 | | | | | |
| 6 | N6 | | | | | |

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FIG. 6E

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | parent node information | | | | | | | | |
| | current node ID | current tree position | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | N4 | 1.3.1 | 6 | | | |
| 2 | N2 | - | N3 | 1.2 | 10 | N5 | 1.4.1 | 8 | N1 | 1.1.1 | 5 |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | N1 | 1.1.2 | 6 | | | |
| 5 | N5 | - | N3 | 1.4 | 8 | **N6** | **1.3.2.1** | **4** | | | |
| 6 | N6 | - | **N5** ~~N4~~ | **1.4.2** ~~1.3.2~~ | **8** ~~4~~ | N4 | 1.3.2 | 4 | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | | | | | |
| 3 | N3* | N1 | N2 | N4 | N5 | |
| 4 | N4 | N6 | | | | |
| 5 | N5 | **N6** | | | | |
| 6 | N6 | | | | | |

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| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | parent node information | | | | | | | | |
| | current node ID | current tree position | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | N4 | 1.3.1 | 6 | | | |
| 2 | N2 | - | N3 | 1.2 | 10 | N5 | 1.4.1 | 8 | N1 | 1.1.1 | 5 |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | N1 | 1.1.2 | 6 | **N6** | **1.4.2.1** | **4** |
| 5 | N5 | - | N3 | 1.4 | 8 | | | | | | |
| 6 | N6 | - | N5 | 1.4.2 | 8 | N4 | 1.3.2 | 4 | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | | | | | |
| 3 | N3* | N1 | N2 | N4 | N5 | |
| 4 | N4 | **N6** | | | | |
| 5 | N5 | N6 | | | | |
| 6 | N6 | | | | | |

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FIG. 6G

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | cur-rent node ID | current tree position | parent node information: parent node: node ID | parent node: associated current node tree position | parent node: capacity to root | first backup parent node: node ID | first backup parent node: associated current node tree position | first backup parent node: capacity to root | ~~second backup parent node~~: node ID | ~~second backup parent node~~: associated current node tree position | ~~second backup parent node~~: capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | N4 | 1.3.1 | 6 | **N2** | **1.2.1** | **5** |
| 2 | N2 | - | N3 | 1.2 | 10 | **N1** ~~N5~~ | **1.1.1** ~~1.4.1~~ | **5** ~~8~~ | N1 | 1.1.1 | 5 |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | N1 | 1.1.2 | 6 | N6 | 1.4.2 | 4 |
| 5 | N5 | - | **N2** ~~N3~~ | **1.2.2** ~~1.4~~ | **9** ~~8~~ | N3 | 1.4 | 8 | | | |
| 6 | N6 | - | N5 | 1.4.2 | 8 | N4 | 1.3.2 | 4 | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | **N5** | | | | |
| 3 | N3* | N1 | N2 | N4 | N5 | |
| 4 | N4 | | | | | |
| 5 | N5 | N6 | | | | |
| 6 | N6 | | | | | |

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FIG. 6H

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | parent node information | | | | | | | | |
| | current node ID | current tree position | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | N4 | 1.3.1 | 6 | N2 | 1.2.1 | 5 |
| 2 | N2 | - | N3 | 1.2 | 10 | N1 | 1.1.1 | 5 | | | |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | N1 | 1.1.2 | 6 | N6 | 1.4.2 | 4 |
| 5 | N5 | - | N2 | 1.2.2 | 9 | N3 | 1.4 | 8 | | | |
| 6 | N6 | - | **N5** ~~N5~~ ~~N5~~ | **1.2.2.2** ~~1.3.2~~ ~~1.4.2~~ | **8** ~~4~~ ~~8~~ | N4 | 1.3.2 | 4 | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | N5 | | | | |
| 3 | N3* | N1 | N2 | N4 | **N5** | |
| 4 | N4 | | | | | |
| 5 | N5 | **N6** | | | | |
| 6 | N6 | | | | | |

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FIG. 6I

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | parent node information | | | | | | | | |
| | current node ID | current tree position | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | N4 | 1.3.1 | 6 | N2 | 1.2.1 | 5 |
| 2 | N2 | - | N3 | 1.2 | 10 | N1 | 1.1.1 | 5 | | | |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | N1 | 1.1.2 | 6 | **N6** ~~N6~~ | **1.2.2.2.1** ~~1.4.2~~ | **4** ~~4~~ |
| 5 | N5 | - | N2 | 1.2.2 | 9 | N3 | 1.4 | 8 | | | |
| 6 | N6 | - | N5 | 1.2.2.2 | 8 | N4 | 1.3.2 | 4 | | | |

600

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | N5 | | | | |
| 3 | N3* | N1 | N2 | N4 | | |
| 4 | N4 | | | | | |
| 5 | N5 | N6 | | | | |
| 6 | N6 | | | | | |

610

FIG. 6J

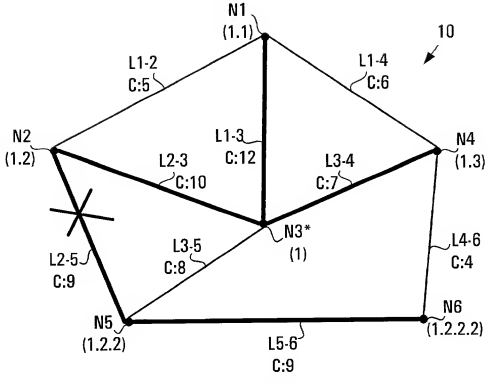


FIG.7A

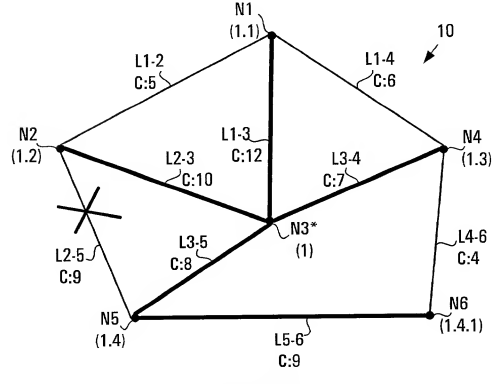


FIG.7B

FOR221*4616200F

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | parent node information | | | | | | | | |
| | cur-rent node ID | current tree position | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | N4 | 1.3.1 | 6 | N2 | 1.2.1 | 5 |
| 2 | N2 | - | N3 | 1.2 | 10 | N1 | 1.1.1 | 5 | | | |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | N1 | 1.1.2 | 6 | **N6** ~~N6~~ | **1.4.1** ~~1.2.2.2.1~~ | **4** ~~4~~ |
| 5 | N5 | - | **N3** ~~N2~~ | **1.4** ~~1.2.2~~ | **8** ~~9~~ | N3 | 1.4 | 8 | | | |
| 6 | N6 | - | **N5** ~~N4~~ ~~N5~~ | **1.4.1** ~~1.3.2~~ ~~1.2.2.2~~ | **8** ~~4~~ ~~8~~ | N4 | 1.3.2 | 4 | | | |

800

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | ~~N5~~ | | | | |
| 3 | N3* | N1 | N2 | N4 | **N5** | |
| 4 | N4 | | | | | |
| 5 | N5 | **N6** | | | | |
| 6 | N6 | | | | | |

810

FIG. 8

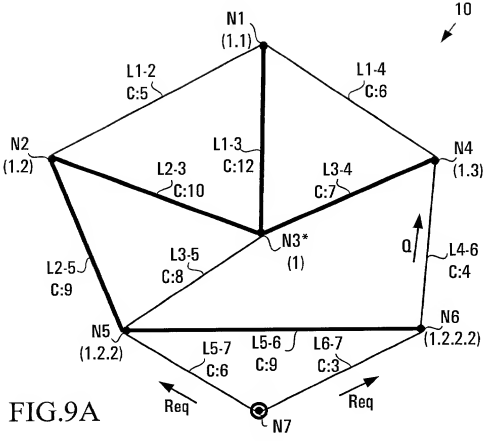


FIG.9A

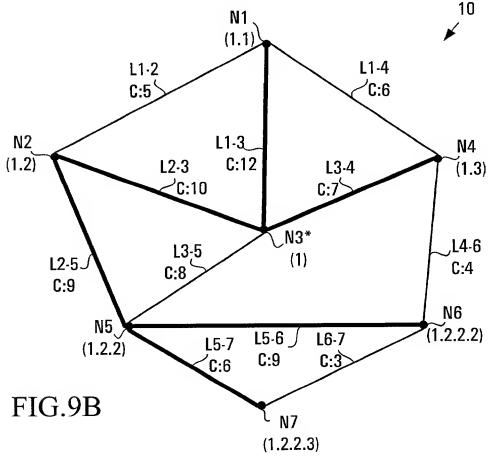


FIG.9B

1002519941.1228001

| | a | b | c | d | e | f | g | h | i | j | k |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | parent node information | | | | | | | | |
| | current node ID | current tree position | parent node | | | first backup parent node | | | second backup parent node | | |
| | | | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root | node ID | associated current node tree position | capacity to root |
| 1 | N1 | - | N3 | 1.1 | 12 | N4 | 1.3.1 | 6 | N2 | 1.2.1 | 5 |
| 2 | N2 | - | N3 | 1.2 | 10 | N1 | 1.1.1 | 5 | | | |
| 3 | N3* | 1 | - | - | - | - | - | - | - | - | - |
| 4 | N4 | - | N3 | 1.3 | 7 | N1 | 1.1.2 | 6 | N6 | 1.2.2.2.1 | 4 |
| 5 | N5 | - | N2 | 1.2.2 | 9 | N3 | 1.4 | 8 | | | |
| 6 | N6 | - | N5 | 1.2.2.2 | 8 | N4 | 1.3.2 | 4 | **N7** | **1.2.2.3** | **3** |
| 7 | **N7** | - | **N5** | **1.2.2.3** | **6** | **N6** | **1.2.2.2.2** | **3** | | | |

| | a | b | c | d | e | f |
|---|---|---|---|---|---|---|
| | node ID | current children | | | | |
| 1 | N1 | | | | | |
| 2 | N2 | N5 | | | | |
| 3 | N3* | N1 | N2 | N4 | | |
| 4 | N4 | | | | | |
| 5 | N5 | N6 | **N7** | | | |
| 6 | N6 | | | | | |
| 7 | **N7** | | | | | |

1000

1010

**FIG. 10**